

Seabirds of Sorol Atoll, Yap, Federated States of Micronesia

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SUMMARY.—Twelve species of seabirds are newly recorded for Sorol Atoll, Yap, Federated States of Micronesia (FSM), with breeding confirmed for nine and likely for two. All of the species are widespread in the tropical Pacific and with few exceptions have been previously recorded breeding on many islands in the FSM. However, Red-tailed Tropicbird *Phaethon rubricauda* on Faluwaichich Island is only the second breeding record for the FSM, and Masked Booby *Sula dactylatra* on Pigelmol Island is only the fourth locality and third breeding record for the country. Sooty Tern *Onychoprion fuscata* and Great Crested Tern *Thalasseus bergii* on Sorol Atoll are first breeding records for Yap State. Breeding seabird colonies were encountered only on the three westernmost islands, Fuluwaichich, Pigelwol and Pigelmol during this study in June and July, but unconfirmed reports by former residents suggest that Sooty Terns breed in large numbers on many islets throughout the atoll in October and November. No birds were observed breeding on Sorol, the largest island in the group and the site of a former settlement, where rats (*Rattus* spp.) and monitor lizards *Varanus indicus*) are common. With the exception of one monitor lizard on Piilalai Island, adjacent to Sorol, no rats or varanids were observed on the other islands.

I visited previously unstudied Sorol Atoll, Yap, Federated States of Micronesia (FSM), from 27 June to 19 July 2011 to assess the distribution and abundance of reptiles, birds, coconut crabs, butterflies and dragonflies (Odonata). I herein report on the seabirds that I observed (I saw no resident landbirds) along with previously unpublished data from one-day visits by Zegrahm Expeditions to Sorol in 2004 and 2010 en route to and from other destinations. The 2010 bird list compiled by J. Rossouw lists only Sorol Atoll as a locality, but G. Lake (<http://travelblog.zeco.com/author/george-lake>), one of the participants, stated that they visited Bigelimol (= Pigelmol) Island. R. Schodde's brief notes on birds observed during the 2004 expedition (held in the Zegrahm archives) likewise mention only Sorol but probably also refer to Pigelmol considering the faunal description.

Study area

Sorol Atoll (08°08'N, 140°25'E) is part of Yap State, and is located in the western Caroline Islands, western Pacific Ocean (Fig. 1A). It is 280 km south-east of the main Yap islands (= Yap proper) and 180 km south of Fais Island, the nearest land. The atoll is c.12 km long and 3 km wide, with six low (2–3 m high) coralline islands distributed along the northern perimeter (Fig. 1B), together with numerous barren sand cays. Total land area is 0.93 km², and Sorol, the largest island, is c.0.5 km² (0.518—Bryan 1971; 0.565—this study, Table 1). The vegetation of Sorol, Fuluwaichich, Pigelwol and Pigelmol Islands is mainly coconut *Cocos nucifera* and tournefortia *Tournefortia argentea* forest that extends to the beach or is bordered by a dense, narrow, discontinuous zone of shrubs and small trees, largely *Scaevola taccada* and *T. argentea*. *Pandanus* sp. is scattered throughout the forest, and sparse coastal scrub occurs on sand and gravel flats between the forest and the shore. *Artocarpus*

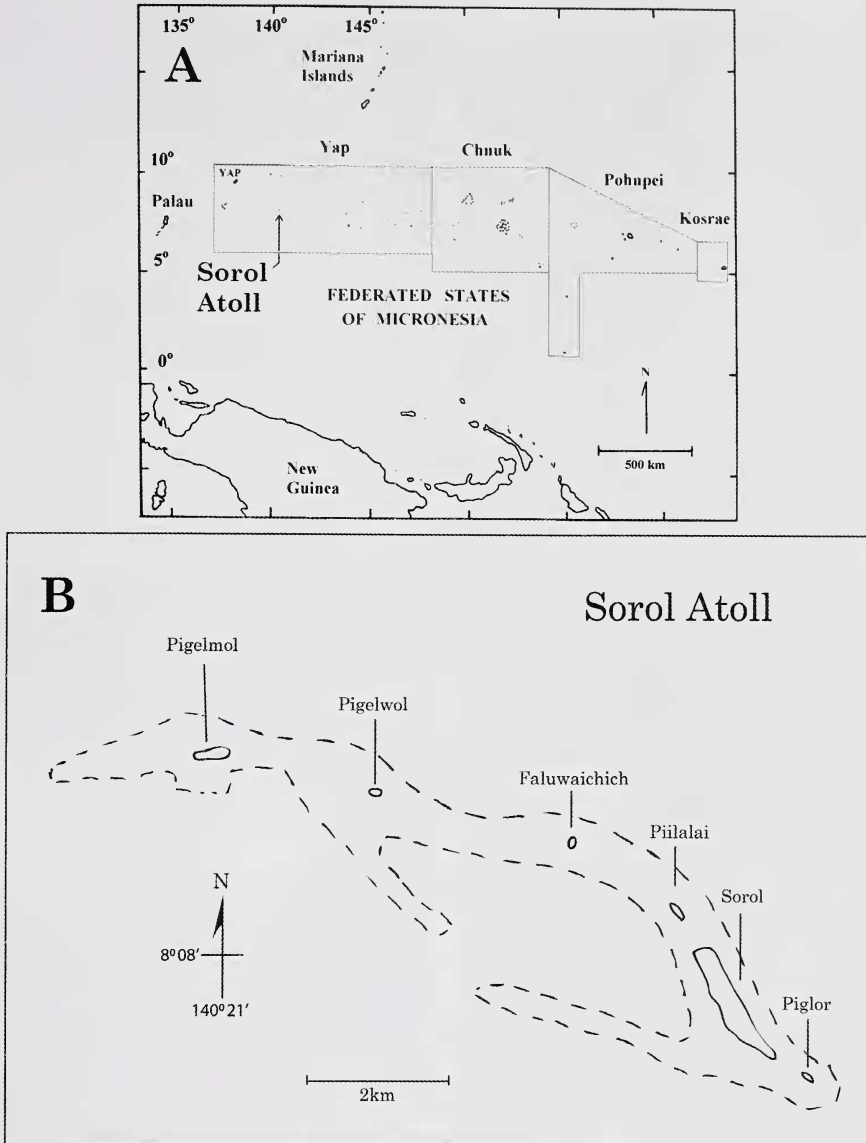


Figure 1. Location of Sorol Atoll in the western Pacific Ocean (A), and the islands of Sorol Atoll (B).

sp., *Barringtonia asiatica*, a *Ficus* sp. and *Pisonia grandis* are among other large forest trees, but many show storm damage and some remain only as dead trunks. Piglor Island, which was once vegetated (M. Marpa pers. comm.), is now a storm-damaged, unvegetated platform of coral sand and rubble, and Piilalai is a long narrow island with *Cocos / Tournefortia / Pandanus* forest over its western half and sparse coastal scrub and strand in the east. The atoll has been sparsely and intermittently inhabited for much of its recorded history, usually with no more than 10–20 people living in a small settlement on Sorol and visiting the other islands of the atoll to fish and to collect crabs, turtles, birds, bird eggs, coconuts and other resources (Buden in press). The atoll has been uninhabited for the past c.10 years (M. Marpa pers. comm.). Islanders from other atolls occasionally visit Sorol, but such visits are infrequent given the distances involved (M. Marpa pers. comm.).

TABLE 1
Statistical data for islands of Sorol Atoll and approximate number of days spent on each island during the present study^a

Island	Length (km)	Width (km)	Area (km ²)	Distance to next island ^b (km)	Days on island
Piglor	0.147	0.082	0.022	0.438	0.5
Sorol	1.870	0.200	0.565	0.140	11.0
Piilalai	0.684	0.050	0.026	1.450	0.5
Faluwaichich	0.202	0.070	0.017	2.570	2.0
Pigelwol	0.380	0.120	0.037	1.930	2.0
Pigelmol	0.667	0.153	0.087	—	7.0

^a Distances and areas measured with a Garmin E-trex GPS unit.

^b From east to west across the atoll.

Methods

I established a base camp on Sorol Island and field camps on Faluwaichich, Pigelwol and Pigelmol Islands during 27 June–19 July 2011. I reached Sorol Island by fishing boat from Yap, and the other islands by walking along the reef flat at low tide. Names of islands are those used by former residents and provided by M. Marpa (pers. comm.), mayor of the Sorol community on Yap; alternative names are listed by Bryan (1971). Common and scientific names of birds follow Clements *et al.* (2011). I recorded the various bird species encountered on each island and confirmed breeding by the presence of eggs and flightless or recently fledged young with down. The major islands and island groups of Micronesia referred to herein include Palau, Yap, Guam, Commonwealth of the Northern Mariana Islands (CNMI), Chuuk, Pohnpei, Kosrae, the Marshall Islands, and Wake Island, following Wiles (2005).

Species accounts

RED-TAILED TROPICBIRD *Phaethon rubricauda*

I saw at least four pairs on Faluwaichich on 1 July 2011. One pair was guarding a downy young (Fig. 2C) and the three others had one egg each (e.g. Fig. 2D). The birds were nesting on the ground in *Cocos* forest. This is the first record of *P. rubricauda* for Yap State and only the second breeding record for FSM; Korte & Meltofte (1997) recorded one pair incubating on Ant Atoll, Pohnpei, on 7 April 1996. This species occurs widely in the tropical Pacific and Indian Oceans (Pratt *et al.* 1987), but there are relatively few breeding records for the western Pacific. Wiles (2005) recorded *P. rubricauda* breeding elsewhere in Micronesia in Palau, CNMI, the Marshall Islands, and Wake Island.

GREAT FRIGATEBIRD *Fregata minor*

I saw this species daily throughout the atoll with max. c.30 in flight over Pigelwol and observed 5–6 recently fledged or nearly fledged young on Pigelmol on 6 July 2011. R. Schodde recorded at least 15 nests on 28 March 2004 [probably on Pigelmol], ‘most of them tended by males’ and J. Rossouw (pers. comm.) observed at least 20 immatures at a nesting site presumably on Pigelmol on 31 August 2010. Great Frigatebird is widespread in the tropical Pacific, Indian and Atlantic Oceans (Pratt *et al.* 1987). Wiles (2005) recorded it on all major islands and island groups in Micronesia, with breeding confirmed in the FSM in Yap, Chuuk and Pohnpei States.

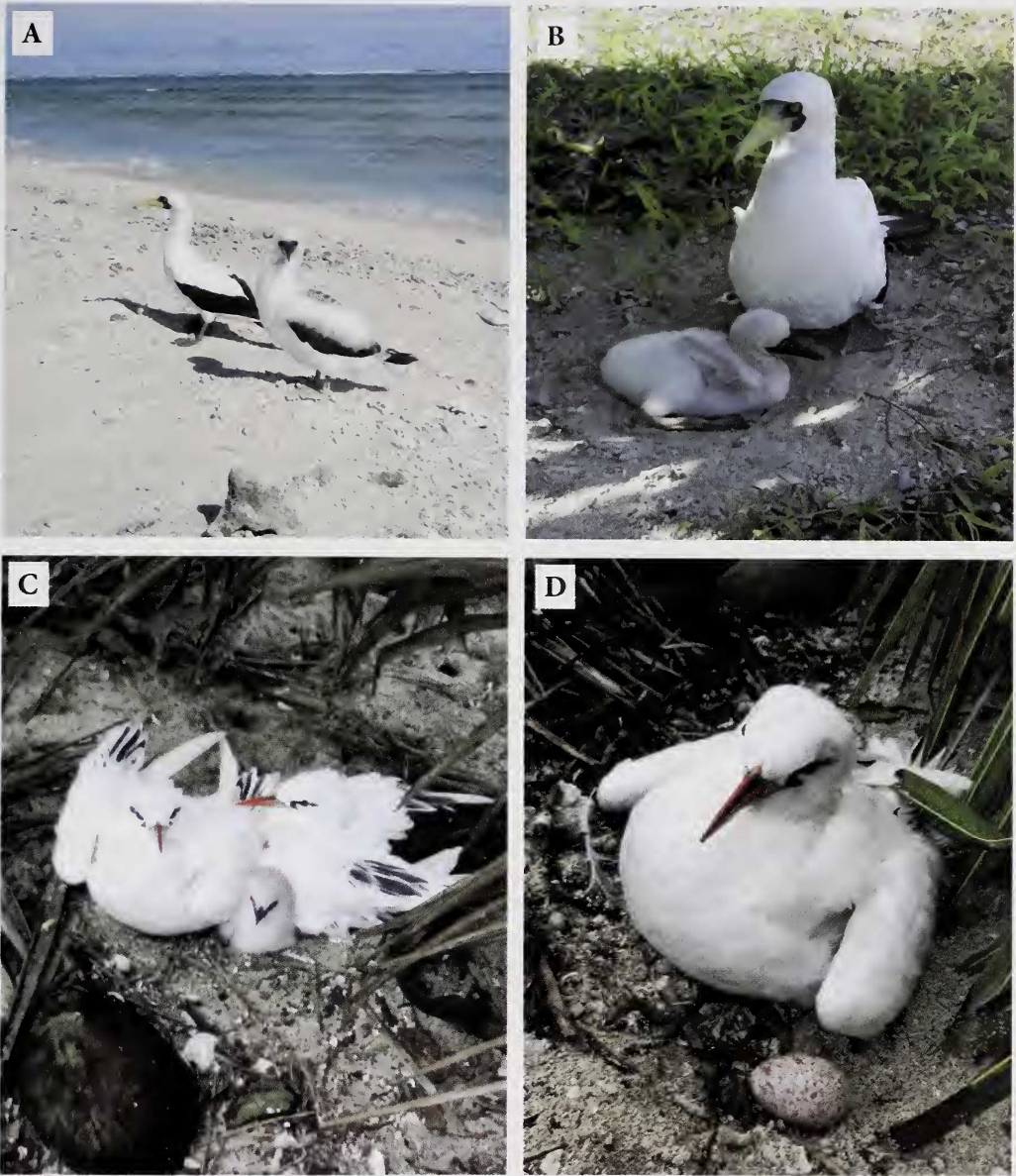


Figure 2. Masked Boobies *Sula dactylatra*, Pigelmol Island, Sorol Atoll, 5 July 2011 (A, B), and two different broods of Red-tailed Tropicbirds *Phaethon rubricauda*, Faluwaichich Island, Sorol Atoll, 1 July 2011 (C, D) (Donald W. Buden)

LESSER FRIGATEBIRD *Fregata ariel*

J. Rossouw (pers. comm.) saw an adult male 'over Sorol Atoll' [presumably on Pigelmol] on 31 August 2010. The only other records for FSM are for Yap proper and Ngulu and Ulithi Atolls (Baker 1951), with a male and female observed at Kosrae (Pyle & Engbring 1987). Pratt *et al.* (1987) considered Lesser Frigatebird to be pantropical in distribution but rare in Micronesia. Wiles (2005) recorded it as occurring in near-shore waters at Palau, Yap, CNMI, Kosrae, the Marshall Islands, and Wake Island, where it may roost on land but is not known to breed.

MASKED BOOBY *Sula dactylatra*

I saw two pairs with different-aged young on Pigelmol on 5 July (Fig. 2A–B), another pair courting there on 6 July, and another (possibly the same) on Pigelwol on 7 July 2011. The courting birds were on the upper beach, occasionally touching bills and making high-pitched honking calls. This species is widely distributed in tropical and subtropical oceans (Pratt *et al.* 1987), but a rare breeder in much of the western Pacific (Nelson 1978). The only other records of *S. dactylatra* in the FSM are two pairs of adults one with a flying juvenile, the other with a downy chick, on 14 September 1999, and a juvenile *c.*100 days old in a nest on 28 May 2002, all on Gaferut Island, Yap (C. B. Kepler *in* Wiles *et al.* 2004), two adults and at least three juveniles on a sand cay at the south-west corner of Murilo Atoll, Chuuk (Wiles *et al.* 2000), and four (ages unstated) roosting on a rock on the reef at East Fayu Island, Chuuk, on 2 April 1996 (Korte & Meltofte 1997).

BROWN BOOBY *Sula leucogaster*

I saw 30–40 adults and juveniles on Faluwaichich on 1 July 2011 and *c.*80–100 adults each on Pigelwol and Pigelmol in the first two weeks of July 2011, many of them in flight or perched atop coconut trees. I observed 13 unoccupied nests and two each with two eggs on the ground in an area of sparse coastal scrub *c.*50 m long and 30 m wide on Pigelwol on 7 July, and saw a nest with two eggs on the ground on Pigelmol on 19 July. R. Schodde recorded ‘dozens of young Brown Boobies on the ground [on Pigelmol?]' on 28 March 2004, and J. Rossouw (pers. comm.) observed at least six pairs nesting (presumably on Pigelmol) on 31 August 2010. This species is widespread throughout tropical oceans (Pratt *et al.* 1987), and breeding (former breeding in the case of Guam) is confirmed for all of the major islands and island groups in Micronesia except Kosrae (Wiles 2005).

RED-FOOTED BOOBY *Sula sula*

I estimated 100–150 adults and juveniles on Faluwaichich on 1 July 2011, another *c.*400 on Pigelwol on 5 July, and fewer (uncounted) on Pigelwol in early July. Many were perched in *Tournefortia* and *Cocos* trees or were seen in flight after being flushed from their perches. R. Schodde recorded ‘over a hundred nests’ in trees [on Pigelmol?] on 28 March 2004, and J. Rossouw (pers. comm.) recorded over 100 breeding on Sorol Atoll (presumably on Pigelmol) on 31 August 2010. This species has a pantropical distribution (Pratt *et al.* 1987) and has been recorded breeding on all major islands and island groups in Micronesia (Wiles 2005).

BROWN NODDY *Anous stolidus*

I saw Brown Noddies regularly throughout the atoll, usually no more than 20–30 together, but up to *c.*300 on a sandbar on Piglor on 10 July 2011. I saw no evidence of nesting but those flushed from atop coconut trees on the three westernmost islands may have had nests hidden from view. R. Schodde recorded Brown Noddies feeding young [on Pigelmol?] on 28 March 2004, and J. Rossouw (pers. comm.) saw ‘100+’ nesting on Sorol (probably Pigelmol) on 31 August 2010. This species is found throughout the tropical oceans of the world (Pratt *et al.* 1987) and has been confirmed to breed on all major islands and island groups in Micronesia (Wiles 2005). It breeds widely in the FSM, but its tendency to nest in the crowns of trees makes accurate assessment of breeding difficult.

BLACK NODDY *Anous minutus*

I estimated *c.*200 on a sandbank between Piilalai and Faluwaichich and another 200 on Faluwaichich on 1 July, and counted *c.*300 old nests, some with adults (but no eggs or young in the few examined), mainly in *Tournefortia* trees on Faluwaichich on 4 July 2011. I

noted nests also on Pigelwol and Pigelmol, but did not make counts, and saw three recently fledged, weak-flying young on Pigelwol on 7 July. R. Schodde recorded Black Noddies 'resting, but not nesting on old nests [on Pigelmol?]' on 28 March 2004. This species occurs widely throughout the tropical Pacific and Atlantic (Pratt *et al.* 1987) and has been confirmed to breed on all major islands and island groups in Micronesia except Guam (Wiles 2005). Black Noddy is one of the commonest seabirds in the FSM (pers. obs.), often nesting in large colonies—e.g. at least 10,000 pairs on East Fayu Island, Chuuk, and c.5,000–10,000 pairs with eggs or nestlings on Ant Atoll, Pohnpei, in April 1996 (Korte & Meltofte 1997).

WHITE TERN *Gygis alba*

I saw White Terns regularly between Piilalai and Pigelmol (but none over Sorol) throughout the period, with a max. 26 together over Faluwaichich on 8 July. I estimated 10–15 breeding pairs and recorded four single-egg clutches on Faluwaichich on 4 July, and 5–6 pairs and one egg on Pigelwol on 7 July. R. Schodde recorded *G. alba* feeding young [on Pigelmol?] on 28 March 2004, and J. Rossouw (pers. comm.) recorded an unspecified number of 'nesting pairs' presumably on Pigelmol on 31 August 2010. White Tern is pantropical in distribution (Pratt *et al.* 1987) and has been recorded breeding on all of the major islands and island groups in Micronesia (Wiles 2005).

SOOTY TERN *Onychoprion fuscata*

I saw c.20 in flight between Piilalai and Faluwaichich, c.100 on a rocky tidal flat at Faluwaichich, and at least three recently fledged, weak-flying young in adjacent coastal scrub on Faluwaichich, all on 3 July 2011. J. Rossouw (pers. comm.) recorded 'small numbers, perhaps prospecting for nesting opportunities' in flight over Sorol Atoll on 31 August 2010. M. Marpa (pers. comm.) and T. Yalochem (pers. comm.), both former residents of Sorol, remarked that in October–November the sand cays are nearly covered with nesting birds, and that one cannot walk there without stepping on the eggs. The birds they described as black above and white below are almost certainly *O. fuscata*. This species is widespread and common in the tropical Pacific (Pratt *et al.* 1987) and Wiles (2005) recorded it on all major islands and island groups in Micronesia, with breeding confirmed for Palau, CNMI, Chuuk, Pohnpei, the Marshall Islands, and Wake Island.

BLACK-NAPED TERN *Sterna sumatrana*

I saw Black-naped Terns only occasionally during my stay on Sorol Atoll, with max. 12 together on sand cays between Piilalai and Faluwaichich on 1 July 2011. Nesting is very probable but unconfirmed. Pratt *et al.* (1987) considered *S. sumatrana* to be widespread and common in the tropical Indian and south-west Pacific Oceans, including most of Micronesia, but rare in the Mariana Islands. Wiles (2005) recorded it on all major islands and island groups in Micronesia except Kosrae and Wake, with breeding confirmed on Palau, Yap, Chuuk, Pohnpei and the Marshall Islands.

GREAT CRESTED TERN *Thalasseus bergii*

I observed a colony of c.70–100 pairs with c.50 flightless but highly ambulatory young and counted 18 single-egg clutches on Pigelwol on 4 July 2011. The half-grown young were on the beach and ran onto the tidal flats at my approach during a second visit on 16 July, when I saw only one egg where I had found 18 previously. I saw no eggshell fragments or any other evidence of predation or hatching and can offer no explanation for their disappearance. There did not appear to be any especially high tides during this period and no storm-induced waves that could have swept the eggs away. This species is widespread

in the tropical Indian and south-west Pacific Oceans (Pratt *et al.* 1987), and, excluding Wake Island, Wiles (2005) recorded *T. bergii* on all major islands and island groups in Micronesia, with breeding confirmed on Palau, Chuuk, Pohnpei and the Marshall Islands.

Discussion

The 12 species of seabirds recorded on Sorol Atoll are widespread in the tropical Pacific (Pratt *et al.* 1987), and 11 of them are confirmed to breed on at least four of the nine major islands and island groups comprising Micronesia (*sensu* Wiles 2005); five of them (Brown Booby, Red-footed Booby, Brown Noddy, Black Noddy and White Tern) breed on at least eight of the nine. Lesser Frigatebird, recorded infrequently in Micronesia, may roost but is not known to breed there. Nearly all of the species have been recorded widely in the FSM, but Red-tailed Tropicbird on Sorol Atoll is only the second country record and there are few records for Masked Booby as well. However, many atolls of the FSM are poorly known biologically and future surveys will probably reveal additional seabird nesting sites.

Nearly all seabird breeding activity on Sorol Atoll is on three small islands at the western end—Fuluwaichich (0.017 km²), Pigelwol (0.037 km²) and Pigelmol (0.087 km²). No nesting was observed on the other islands, but two former residents independently described what would appear to be many thousands of Sooty Terns nesting throughout the atoll during October and November of each year. The apparent absence of any significant nesting on Sorol Island, which is the largest of the group, probably reflects the abundance of introduced predators there. Rats (*Rattus* spp.) were common and I trapped seven examples of the *R. rattus* complex in two nights using a single snap trap, and saw several possible *R. exulans*. Monitor lizards *Varanus indicus* were also common on Sorol and I frequently encountered 15–20 during circumferential walks along the beach, and saw others in the forest. Many of those on the beach were excavating turtle nests and feeding on the eggs.

Monitor lizards were introduced to Sorol Atoll during the Japanese administration (M. Marpa pers. comm.), presumably as a supplementary food source and / or for rat control, as on many other islands in the FSM (Buden 2000). But as rat control agents, monitor lizards appear to be ineffectual, at least on Sorol where rats and monitor lizards both flourish, the rats being active mainly at night and the lizards principally by day (pers. obs.). With the exception of one monitor lizard on Piilalai, immediately adjacent to Sorol, I saw none elsewhere on the atoll. Uchida (1966) reported that residents of Ifaluk Atoll, Yap, c.450 km east of Sorol, claim that wild birds, chickens and their eggs are among the prey of monitor lizards, and Gajdusek (*in* Buden 2011) stated that residents of Fais Island, Yap, 180 km north of Sorol, attributed the near absence of Micronesian Starling *Aplonis opaca* from the island to predation by monitor lizards. In 2005, a resolution was introduced during the Fourteenth Congress of the FSM (C. R. No. 14-24) to request assistance from the Japanese government to eradicate monitor lizards in Yap. The resolution stated that the lizards were used by the Japanese administration to kill rats on the islands and went on to say that the monitor lizards also ‘...feed on turtle eggs, mangrove crabs, chickens, small mammals and bird eggs, and thereby endanger the domestic food source of the people of Yap State’. The resolution was assigned to the External Affairs Committee for further review and no subsequent action was taken (L. Ramon, Chief Clerk, FSM Congress, pers. comm.).

Piglor Island, a storm-damaged platform of coral rubble immediately east of Sorol Island, may host ground-nesting birds at times, but I saw no evidence of this. During low tides, potential predators could easily reach Piglor from Sorol without having to swim. Piilalai Island immediately to the west of Sorol also may host a few nesting birds from time to time, but its proximity to Sorol also makes it vulnerable to invasion by predators, and I observed at least one monitor lizard there. At present, the breeding colonies on the three

most remote islands at the west end of Sorol Atoll appear to be unthreatened by human exploitation or by introduced predators, with the only major threat being natural disasters such as typhoons that pass over these islands occasionally.

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